CLAIMS

What is claimed is:

1. A moldable implant composition for use in repairing a bone defect in a living organism, comprising:

a plurality of biocompatible granules;

a biocompatible polymer on at least a portion of said biocompatible granules so as to form an implant mass comprising said biocompatible granules and said biocompatible polymer; and

a plasticizer in said implant mass in an amount sufficient to condition at least a portion of said biocompatible polymer so that said implant mass is initially plastically deformable into a desired shape and then hardenable upon removal of at least a portion of said plasticizer from said implant mass.

2. A moldable implant composition as defined in claim 1, wherein the biocompatible granules comprise a material selected from the group consisting of biocompatible ceramics, biocompatible glasses, biocompatible polymers, and combinations thereof.

3. A moldable implant composition as defined in claim 1, wherein the biocompatible granules comprise a material selected from the group consisting of silicon oxide, calcium sulphate, calcium phosphate, and combination thereof.

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4. A moldable implant composition as defined in claim 1, wherein the biocompatible granules comprise a material selected from the group consisting of monocalcium phosphate monohydrate, monocalcium phosphate anhydrous, dicalcium phosphate dihydrate, dicalcium phosphate anhydrous, tetracalcium phosphate, calcium orthophosphate phosphate, calcium pyrophosphate, α-tricalcium phosphate, β-tricalcium phosphate, hydroxyapatite, carbonate hydroxyapatite, apatite, bioglass, and combination thereof.

5. A moldable implant composition as defined in claim 1, wherein the biocompatible granules are biodegradable.

6. A moldable implant composition as in defined claim 1, wherein said biocompatible polymer is biodegradable.

7. A moldable implant composition as defined in claim 1, wherein said biocompatible polymer is selected from the group consisting of poly(α-hydroxyesters), poly(orthoesters), poly(ether esters), polyanhydrides, poly(phosphazenes), poly(propylene fumarates), poly(ester amides), poly(ethylene fumarates), poly(amino acids), polysaccharides, polypeptides, poly(hydroxy butyrates), poly(hydroxy valerates), polyurethanes, poly(malic acid), polylactides, polyglycolides, poly(lactide-co-glycolide), polycaprolactones, poly(glycolide-co-trimethylene carbonates), polydioxanones, and co-polymers, terpolymers thereof and blends of those polymers.

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8. A moldable implant composition as defined in claim 1, wherein the biocompatible polymer comprises poly(lactide-co-glycolide).

9. A moldable implant composition as in claim 1, wherein said plasticizer is selected from the group consisting of n-methyl-2-pyrrolidone, acetone, ethyl lactate, ethyl acetate, ethyl formiate, acetyltributylcitrate, triethyl citrate, lactic acid, citric acid tetrahydrofuran, toluene, alcohol and carbon dioxide.

10. A moldable implant composition as in defined claim 1, further comprising a biologically active substance.

11. A moldable implant composition as in defined claim 1, wherein said plasticizer is extractable from said implant mass when contacted with a hardener.

12. A moldable implant composition as defined in claim 11, wherein said hardener comprises water or a body fluid.

13. A moldable implant composition as defined in claim 1, wherein said implant mass comprises a substantially solid composite matrix.

14. A moldable implant composition as defined in claim 1, wherein said implant mass comprises a porous scaffold.

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15. A moldable implant composition as defined in claim 1, further comprising a membrane on a surface of said implant mass.

16. A moldable implant composition as defined in claim 1 disposed in a syringe that is capable of injecting the moldable implant composition into a bone defect.

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17. A moldable implant composition for use in repairing a bone defect in a living organism, comprising:

a plurality of biocompatible granules comprising a biocompatible polymer, the plurality of biocompatible granules together forming an implant mass;

a plasticizer in said implant mass in an amount sufficient to condition at least a portion of said biocompatible polymer so that said implant mass is initially plastically deformable into a desired shape and then hardenable upon removal of at least a portion of said plasticizer from said implant mass.

18. A moldable implant composition as defined in claim 17, wherein said biocompatible polymer is selected from the group consisting of poly(α-hydroxyesters), poly(orthoesters), poly(ether esters), polyanhydrides, poly(phosphazenes), poly(propylene fumarates), poly(ester amides), poly(ethylene fumarates), poly(amino acids), polysaccharides, polypeptides, poly(hydroxy butyrates), poly(hydroxy valerates), polyurethanes, poly(malic acid), polylactides, polyglycolides, poly(lactide-co-glycolide) polycaprolactones, poly(glycolide-co-trimethylene carbonates), polydioxanones, and co-polymers, terpolymers thereof and blends of those polymers.

19. A moldable implant composition as defined in claim 17, wherein said plasticizer or solvent is selected from the group consisting of n-methyl-2-pyrrolidone, acetone, ethyl lactate, ethyl acetate, ethyl formiate, acetyltributylcitrate, triethyl citrate, tetrahydrofuran, toluene, alcohol and carbon dioxide.

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20. A moldable implant composition as in claim 17, wherein said plasticizer is extractable from said implant mass when contacted with a hardener.

21. A moldable implant composition as defined in claim 20, wherein said hardener comprises water or a body fluid.

22. A moldable implant composition as defined in claim 17 disposed in a syringe that is capable of injecting the moldable implant composition into a bone defect.

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23. A method for repairing a defect or wound in a bone of a living organism, comprising:

forming an implant mass comprising a plurality of biocompatible granules and a biocompatible polymer;

exposing said implant mass to a plasticizer to condition said biocompatible polymer to yield a moldable implant mass plastically deformable; and

shaping the moldable implant mass into desired shape for repairing a bone defect in a living organism.

24. A method as defined in claim 23, wherein exposing said implant mass to a plasticizer comprises immersing said implant mass in a liquid plasticizer.

25. A method as defined in claim 23, wherein exposing said implant mass to a plasticizer comprises immersing said implant mass in a gaseous plasticizer.

26. A method as defined in claim 23, wherein the moldable implant mass is contained in a syringe and shaping the moldable implant mass comprises injecting the moldable implant mass into a bone defect using the syringe.

27. A method as defined in claim 23, wherein shaping said moldable implant mass comprises placing said moldable implant mass in a bone defect in a living organism.

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28. A method as defined in claim 27, wherein said moldable implant mass hardens as a result of said plasticizer being extracted from said moldable implant mass by body fluid in contact therewith.

29. A method as defined in claim 23, wherein shaping said moldable implant mass comprises:

placing said moldable implant mass into a mold having a mold cavity corresponding to a shape of a bone defect in order for said implant mass to be formed into the shape of the bone defect;

applying a hardening substance to said shaped implant mass to cause said shaped implant mass to harden; and

removing said hardened implant mass from said mold and inserting the solidified implant mass into a bone defect in a living organism.

30. A method as defined in claim 29, wherein said hardening substance comprises water that causes hardening by extracting said plasticizer from said implant mass.

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31. A method for repairing a defect or wound in a bone of a living organism, comprising:

mixing a biocompatible polymer with a plasticizer to condition said biocompatible polymer;

coating a plurality of biocompatible granules with said conditioned biocompatible polymer; and

placing said coated granules in a mold or bone defect to form a shaped implant mass.

32. A method as defined in claim 31, wherein said coated granules are placed in a bone defect to form said shaped implant mass.

33. A method as defined in claim 32, further comprising extracting said plasticizer from the shaped implant mass by a body fluid in contact therewith in order to cause said shaped implant mass to harden.

34. A method as defined in claim 31, wherein placing said coated granules further comprises:

filling a mold with said coated granules;

applying a hardening substance to said shaped implant mass to cause said shaped implant mass to harden; and

removing said solidified implant mass from said mold and inserting said solidified implant mass into a bone defect.

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35. A method as defined in claim 34, wherein said hardening substance comprises water, which causes hardening by extracting said plasticizer from said implant mass.

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36. A method for repairing a defect or wound in a bone of a living organism, comprising:

forming an implant mass comprising a plurality of biocompatible granules, a biocompatible polymer, and a plasticizer, the plasticizer being selected to give the biocompatible polymer a desired glass transition temperature;

exposing said implant mass to a temperature higher than said glass transition temperature of the biocompatible polymer to yield a moldable implant mass plastically deformable; and

shaping the moldable implant mass into a desired shape for repairing a bone defect in a living organism.

37. A method as defined in claim 36, wherein shaping said moldable implant mass comprises placing said moldable implant mass in a bone defect in a living organism.

38. A method as defined in claim 37, wherein said moldable implant mass hardens as a result of the temperature of said biocompatible polymer dropping below the glass transition temperature.

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39. A method as defined in claim 37, wherein shaping said moldable implant mass comprises:

placing said moldable implant mass into a mold having a mold cavity corresponding to a shape of a bone defect in order for said implant mass to be formed into the shape of the bone defect;

cooling said implant mass to a temperature below the glass transition temperature to cause said shaped implant mass to harden; and

removing said hardened implant mass from said mold and inserting the solidified implant mass into a bone defect in a living organism.

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40. A method for repairing a defect or wound in a bone of a living organism, comprising:

forming an implant mass comprising a plurality of biocompatible granules and a biocompatible polymer, the biocompatible polymer being selected to have a desired glass transition temperature;

exposing said implant mass to a temperature higher than said glass transition temperature of the biocompatible polymer to yield a moldable implant mass plastically deformable; and

placing the moldable implant mass in a bone defect of a living organism.

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